

SECTION 15060
HVAC PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to work of this section.

1.2 WORK INCLUDED

- A. Chilled water, hot water, and chemical feed system piping.
- B. Condensate drain piping.
- C. Pipe welding.
- D. Inspection of pipe welds.
- E. Examination of pipe welds.
- F. Leak testing of piping systems.

1.3 QUALITY ASSURANCE

- A. Furnish certified record of welding qualification test for each welder, and welding operator, prior to beginning welding operations.
- B. Furnish certified laboratory test report for each weld specimen subjected to laboratory testing.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced to in the text by the basic designation only.
 - 1. American Iron and Steel Institute (AISI) Publication:
 - a. Steel Products Manual.
 - 2. American National Standards Institute (ANSI) Standards.
 - 3. American Society of Mechanical Engineers (ASME) Publications:
 - a. Section VIII Pressure Vessels, Division 1.
 - b. Section IX Welding and Brazing Qualifications
 - 4. American Society for Testing and Materials (ASTM) Publications.
 - 5. American Welding Society (AWS).

6. The Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

1.5 WELDING

- A. Piping welded in accord with qualified procedures using performance qualified welders and welding operators. Full penetration welds are required.
- B. The Contractor is responsible for testing and qualifying the welders assigned to do the work, including the required test welds.
- C. Submit certified record of welding qualification test for each welder assigned to do the work.
- D. Each weld in the piping system, including required test welds, will be visually examined by the Architect for imperfections in accord with ANSI B31.1.
- E. Defective work shall be corrected in accord with the General Conditions.
- F. Welds exhibiting visual evidence of poor workmanship or excessive leaking under test, at the Architect's option, shall be subjected to additional nondestructive inspection or mechanical testing in accord with ANSI B1.0 or B4.0.
 1. Additional tests will require the services of a certified testing laboratory.
 2. Should additional tests detect unacceptable defects not detectable by visual inspection the work shall be deemed to be concealed and the cost of the additional tests shall be borne by the Contractor in accord with the General Conditions.

1.6 SUBMITTALS

- A. Comply with Section 15000, Mechanical General Provisions.
- B. Submit manufacturer's data and certificate of conformance on the following:
 1. Pipe
 2. Pipe fittings
- C. Submit certified record of welding qualification test for each welder.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall conform to the respective publications and other requirements specified herein.

2.2 PIPE

- A. Where more than one type of material is listed for a specific system the Contractor may select any of the types of materials specified for that particular piping system.

B. Materials for Piping Systems:

<u>Systems</u>	<u>Materials</u>
1. Chilled Water, Chemical Feed, Hot Water, 2-1/2" and above	a. Pipe, Steel: ASTM A53, ASTM A120, standard weight, black. Pipe Fittings, Steel: ASTM A234, marking WPA for welding fittings. Butt-welding Fitting: ANSI B16.9. Socket Welding Fittings: ANSI B16.11. Malleable iron threaded fittings, Class 150 & 300; ANSI B16.3.
2. Chilled Water, Chemical Feed, Hot Water, 2" and below	b. Pipe, Copper Tubing: ASTM B88, hard drawn, type L. Pipe Fittings: ANSI B16.22, wrought copper. Solder Metal: ASTM B32, 95-5 (tin-antimony-grade 95 TA).
3. Condensate Drains	a. Pipe, Copper Tubing: ASTM B88, hard drawn, type L. Pipe fittings: ANSI B16.22, wrought copper. Solder Metal: ASTM B32, 95-5 (Tin-antimony grade 95 TA). (size 1 in. maximum.) b. Pipe, Copper Tubing: ASTM B306 Copper drainage tube, (DWV). Pipe Fittings: ANSI B16.23, cast copper alloy solder joint drainage fittings, DWV. Solder Metal: ASTM B32, 95-5 (tin-antimony-grade 95TA). (size 1-1/4 in. and larger). c. Pipe, PVC: ASTM D1785, Schedule 40. Pipe Fittings: ASTM D2466, PVC. Solvent Cement: ASTM D2564.

2.3 PIPE THREADS

- A. Pipe threads shall conform to ANSI B2.1. Threads that are corroded, stripped, chipped, flattened, or damaged in any other way, are not acceptable.

2.4 UNIONS

- A. Unions shall be used on pipe sizes 2-1/2 inches and smaller.
 - 1. Unions for steel pipe shall be in accord with ANSI B16.39, malleable iron, threaded, Class 150 and 300, black or galvanized to match adjacent piping.
 - 2. Unions for copper pipe shall be combination wrought copper/red bronze, or cast bronze, solder ends, Class 150.
- B. Unions for pipe sizes 3 inches and larger shall be companion flange type.
 - 1. Companion flanges for steel pipe shall be steel, slip-on welding type, 150 lb.
 - 2. Companion flanges for copper pipe shall be in accord with ANSI B16.24, cast-bronze, solder connections, 125 lb.
- C. Dielectric unions shall have metal connections on each end threaded to match adjacent piping. Metal components shall be separated by nylon insulator to prevent current flow between dissimilar metals. Unions shall be suitable for the required system operating temperatures and pressures.

2.5 FLANGES

- A. Bronze flanges shall be in accordance with ANSI B16.24.
- B. Steel flanges shall be in accordance with ASTM A181, Class 60, with dimensions in accord with ANSI B16.5.
- C. Flanges shall have the manufacturer's trademark affixed in accord with MSS SP-25 so as to permanently identify the manufacturer.

2.6 GASKETS

- A. Flange gaskets shall be fiber, plastic, rubber, or other synthetic material suitable for the intended service.
- B. Nonmetallic gaskets shall be in accord with ANSI B16.21.
- C. Rubber-compound gaskets shall be in accord with ASTM D2000, No AA 708A132. Rubber in gasket shall have nonblooming surface, durometer hardness of 75 plus or minus 5, minimum tensile strength of 1500 psi, and a minimum elongation of 150 percent.

2.7 BOLTS AND NUTS

- A. Squarehead bolts and heavy hexagon nuts shall be in accord with ANSI B18.2.1 and B18.2.2, ASTM A307, A575, or A576.
- B. Bolts for underground service shall be in accord with ASTM A325.

2.8 MECHANICAL JOINTS

- A. Mechanical joints may be provided in lieu of unions and welded, flanged or screwed piping joints in above ground black steel piping for chilled water systems.
- B. Pipe with wall thicknesses less than Schedule 30 in sizes 8 inches and larger, or Schedule 40 in sizes smaller than 8 inches shall not be joined with couplings used with pipe having cut grooves. Use rolled grooves only.
- C. Mechanical joints shall be of the external coupling type for use with cut grooved or rolled grooved end pipes, fittings, and valves.
- D. Mechanical couplings shall be self-centering, and shall engage and lock in place the grooved end pipes, fittings, and valves.
- E. Coupling housing clamps shall be malleable iron casting fabricated in two or more parts.
- F. Coupling gaskets shall be molded synthetic rubber.
- G. Coupling assembly shall be held together by two or more track-head, square, or oval neck steel bolts.
- H. The coupling assembly shall be designed for not less than 125 psi service at 230 degrees F, and shall be appropriate for the system pumping head plus the system static head.
- I. Mechanical couplings and fittings shall be of the same manufacturer.

2.9 PIPE FITTINGS

- A. Pipe fittings, where applicable, shall have the manufacturer's trademark affixed in accord with MSS SP-25 so as to permanently identify the manufacturer.

2.10 CUTTING OIL

- A. Thread-cutting oil shall be an all-purpose lubricant free from animal or vegetable compounds.

2.11 PIPE THREAD COMPOUND

- A. Screwed pipe joints shall have male threads only coated with graphite, or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene (PTFE) tape applied.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Pipe tubing shall be cut square and smooth, shall have burrs removed by reaming, and shall have scale, dirt, and welding slag removed from inside and outside.
- B. Pipe fittings shall be examined for damage and defects, and shall have scale, dirt, and rust removed from inside and outside. Damaged or defective fittings, and fittings showing excessive rust, shall be replaced with acceptable fittings.

- C. Use wire brush and compressed air to remove rust, dirt, and other foreign material from pipe and fitting threads prior to application of pipe thread compound, or PTFE tape.
- D. Use flat file to remove welding spatter and slag from face of flanges. Chipping or grinding is not permitted.

3.2 INSTALLATION

A. General Requirements

1. Installation shall be as required by the applicable Code listed in the General Conditions, Supplementary Conditions, and the applicable Section of Division 1 General Requirements. Comply with Section 15000, Mechanical General Provisions.
2. Pipe openings shall be closed with caps or plugs during installation.
3. Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Above ground piping shall run parallel with the building lines, unless otherwise indicated. Pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1 inch clearance between finished covering on the different services. Bare and insulated pipes shall not bear directly against building structural elements so as to transmit sound to the structure or prevent flexible movement of the lines.
4. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted. Change in direction shall be made with fittings, except that bending of steel and copper pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations is not acceptable.
5. Allowance shall be made throughout for expansion and contraction of piping subject to expansion. Each riser and horizontal run of piping shall be provided with expansion joints, or expansion compensators where required. Piping shall be securely anchored as required or where indicated to force expansion to the expansion device without bending, binding, or misalignment of pipe. Branch connections from mains to risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Where indicated, in lieu of expansion joints, or expansion compensators, horizontal runs of pipe shall be anchored at approximately midway of the run to force expansion, evenly divided, toward the mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.
6. Joints between sections of black steel pipe and between black steel pipe and fittings size 2-1/2 inches and larger shall be welded.
7. Mechanical joints may be provided in lieu of welded or flanged piping connections in black steel piping. Pipe grooving and coupling installation shall be in accord with the manufacturer's written instructions.
8. Welded joints shall be fusion welded unless otherwise required. Changes in direction of piping shall be made with welding fittings only, except that bending of

pipe sizes 4 inches and smaller will be permitted. Mitering or notching of pipe to form elbows and tees, or other similar type construction, will not be permitted. Branch connections may be made with either welding tees or branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of welds shall conform to Article 1.5 WELDING this Section. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded at no change in Contract price. Electrodes shall be stored and dried in accord with AWS D1.1, or as recommended by the manufacturer. Electrodes that have been wetted, or that have lost any of their coating, shall not be used. The welding process shall be performed in accord with NFPA No. 51B, Standard for Fire Prevention in Use of Cutting and Welding Processes.

9. Threaded joints shall be made with tapered threads in accord with ANSI B2.1, and made tight with an approved pipe thread joint compound or material, applied to the male threads only. Use compounds sparingly and apply with caution to ensure that compounds do not enter piping systems. When pipe joint is made up a maximum of 3 threads shall be visible.
10. Joints in copper tubing shall be made with solder-type fittings. Outside surface of the tube where engaged in the fitting, and inside surface of the fitting in contact with the tube, shall be cleaned with an abrasive material before soldering. Self-cleaning compounds are not allowed. Care shall be taken to prevent annealing of tube and fittings when making connections. Solder joint shall be made with flux and wire form solder, except brazed joints. The flux shall be mildly corrosive liquid or petroleum based paste containing chlorides of zinc and ammonium. Solder shall be applied and drawn through the full fitting length. Excess solder shall be wiped from joint before solder hardens. Joints in copper tube sizes 2-1/2 inches and larger shall be made with heat applied uniformly around the entire circumference of the tube and fittings by a multiflame torch. Use of oxy-acetylene cutting torch in lieu of multiflame torch is not permitted.
11. Exterior surfaces of steel pipe, and pipe fittings, installed below ground shall be thoroughly cleaned of foreign matter by wire brushing and solvent cleaning. The pipe shall be primed and immediately wrapped with tape, applied with a 50 percent overlap. Tape shall conform to AWWA C203, and primer shall be as recommended by the tape manufacturer. Joints and fittings shall be covered with the same primer and tape. Fittings shall be coated and wrapped after piping has been tested. Pipe shall be coated and wrapped during installation.
12. Silver brazing joints shall be in accord with MSS SP-73 Silver Brazing Joints for Wrought and Cast Solder Joint Fittings.
13. Clean PVC fitting hubs and pipe ends with PVC primer prior to application of solvent cement. Solvent cement shall be applied to male ends only. Seal shall be uniform around entire perimeter of joint or joint shall be removed and remade.
14. Connections between ferrous and nonferrous metallic pipe shall be made with dielectric unions or flanges.
15. Provide unions or flanged connections at all equipment.

16. Unions and flanges shall not be concealed in walls, partitions, or above inaccessible ceilings.

B. Hydronic HVAC Systems Additional Requirements

1. Make branch connections to top of mains for upfeed arrangement, and to bottom of mains for downfeed arrangement, except where main and branch line are of equal size the branch connections may be made to the side of the main for both upfeed and downfeed applications.
2. Slope horizontal condensate drain piping minimum 1/4 inch per foot.
3. Provide water seal in the condensate drain from each A.C. unit. The depth of each seal shall be equal to the total static pressure rating of the unit to which the seal is connected. Water seals shall be constructed of two tees and an appropriate U bend with the open end of each tee plugged.

3.3 LEAK TESTING

- A. The Architect will witness all leak tests. Notify Architect at least 24 hours in advance of tests.
- B. Where tests are to be witnessed and approved by the Building Official, notify Official and obtain approval. Where written approval is furnished, submit copy of approval.
- C. Work, or portions of work, that is altered in any way after testing and approval shall be retested, witnessed, and approval obtained.
- D. Work requiring testing shall not be covered, or otherwise concealed, until testing is completed and approval is granted.
- E. Systems requiring hydrostatic tests shall be protected from damage caused by freezing. After tests are completed, drain all sections of pipe, including traps, or fill undrained sections and traps with antifreeze solution. Vent all high points to release vacuum and ensure complete drainage of closed systems, and blow out piping with compressed air to remove trapped water.
- F. Duration of tests, unless specified otherwise, shall be the time required to examine each joint in the system being tested.
- G. Systems requiring hydrostatic testing under pressure shall be vented at high points to ensure that all piping is completely filled with the testing medium.
- H. During tests, isolate system components that have test pressures less than pressures specified for system tests.
- I. Use clean soapy water applied to exterior of joints to locate leaks in systems using compressed air, dry carbon dioxide, or nitrogen, under positive pressure as a test medium.
- J. The various piping systems shall be leak tested as specified below:
 1. Chilled Water, Hot Water, and Chemical Feed shall be tested with water at 1-1/2 times the system working pressure, but not less than 100 psig. Joints will be

visually examined for leaks. Welded joints shall be hammer tested under pressure.

- K. Leaks, if any, shall be located, repaired, and retested in accord with the test method specified for the system in which the leaks are located.

END OF HVAC PIPE AND PIPE FITTINGS